FLUVIAL ARCTIC GRAYLING MONITORING REPORT 2004

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Submitted To:

Fluvial Arctic Grayling Workgroup

And

Beaverhead National Forest
Bureau of Land Management
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The Arctic Grayling Recovery Program is directed by FWP. We thank all the funding sources for support and contributions in 2004. Funds in 2004 were provided by FWP, Montana Trout Unlimited, the Montana Chapter of the American Fisheries Society, PPL-Montana, the Bureau of Land Management (BLM), the USFWS (Section 6, State Wildlife Grants) and the Landowner Incentive Program (LIP). We appreciate the efforts from the Patagonia Outlet in Dillon for designing, providing, and selling the Arctic grayling T-shirts with all profits going to the Arctic grayling Recovery Program.

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INTRODUCTION

The fluvial Arctic grayling (Thymallus arcticus) of the Big Hole River represent the last, strictly fluvial native grayling population in the continental United States. After the population declined during the mid-1980's, Montana Fish, Wildlife & Parks (FWP) initiated the Arctic Grayling Recovery Program. The program's goals are to determine ecological factors limiting the grayling population, monitor abundance, restore grayling within there native range, and to inform the general public of their plight. Monitoring and research results have been reported annually since 1991 (Byorth 1991, 1993, 1994, 1995a, 1997, Magee and Byorth 1995, Byorth and Magee 1996, Magee and Byorth 1998, Magee 1999, Magee and Opitz 2000, Magee 2002, Magee and Lamothe 2003).

Objectives of the project from January 1 through December 31, 2004 were to:

A. Monitor abundance and distribution of grayling and potential competitors in the Upper Big Hole Basin.

B. Monitor water temperatures and discharge in the Big Hole River and tributaries.

C. Promote habitat and instream flow conservation efforts among Big Hole Basin landowners, and serve as a technical advisor for the Big Hole Watershed Committee.

D. Monitor grayling broodstock populations at Axolotl Lake, collect gametes, and supplement additional year classes as needed.

E. Monitor the grayling broodstock population in Green Hollow II Reservoir, collect gametes, and plant additional year classes as needed.

F. Assess feasibility of Candidate Conservation Agreements with Assurances Program (CCAA) in the Upper Big Hole drainage.

G. Continue to stock hatchery-reared grayling or use Remote Site Incubators (RSI) and monitor survival and abundance of these efforts on the Upper Ruby, North and South Fork of the Sun, and Missouri River Headwaters restoration sites.

H. Continue assisting Montana Department of Natural Resources and Conservation (DNRC) assessments of instream flow regimes in the Upper Big Hole River.

Results for objectives A through F, G, and H are reported in the body of this report, Appendix A, and Appendix B respectively.

STATUS

Fluvial Arctic grayling in Montana are designated as a fish of "Special Concern" by FWP, the Endangered Species Committee of the American Fisheries Society, the Montana Chapter of the American Fisheries Society and the Montana Natural Heritage Program (Holton 1980: Williams et al. 1989: Clark 1989, Genter 1992). The United States Forest Service (USFS) classifies fluvial Arctic grayling as a sensitive species. In October 1991, the United States Fish and Wildlife Service (USFWS) received a petition to list fluvial grayling in Montana throughout it historic range under the Endangered Species Act (ESA). The USFWS 1994 finding classified fluvial grayling in Montana as a Category 1 species, which indicates that there is enough information on file to support a proposal to list the grayling as threatened or endangered. In March 2004, the USFWS elevated grayling in listing priority for a Distinct Population Segment (DPS) from a level 9 to a level 3. This is the highest priority level given to a DPS. This elevated priority level was because; 1) the current distribution of fluvial grayling represents less than 5% of the historic range, and 2) recent population surveys suggest decline in the Big Hole River population. In May of 2004 the USFWS was sued to emergency list the fluvial grayling.

At this time the lawsuit is on-going and the outcome is unknown.

METHODS

Habitat Evaluation

Water Temperatures and Stream Discharge

The U.S. Geological Survey (USGS) measured discharge of the mainstem Big Hole River from April through October at the Wisdom Station, the Mudd Creek Station, and year round at the Melrose Station (USGS 2004) (Figure 1). Aqua rods (Sequoia Version 4.0 2003) were also installed to spatially assess flow dynamics in the Upper Big Hole River and tributaries. Aqua rods were placed at Saginaw Bridge, Petersons Bridge, below the mouth of Steel Creek, at the mouth of the North Fork and at Steel Creek (Figure 1). Water temperature was monitored at the USGS Wisdom and Melrose stations, the 5 aqua rod sites and 14 thermograph stations located in the mainstem Big Hole or tributaries (Figure 2). FWP used Onset Hobotemp and Stowaway thermographs to record temperatures at 60-minute intervals. Data were downloaded into Microsoft Excel and reduced to daily maximum, minimum, and average temperatures.

Conservation Efforts

In 2004, FWP worked closely with local water users, the USFWS's Partners for Fish and Wildlife Program (PFWP), the Big Hole Watershed Committee (BHWC), DNRC, Natural Resources and Conservation Service (NRCS) and Trout Unlimited to maintain and enhance instream flows in the Big Hole River. Due to below average snowpack and spring instream flows the NRCS offered landowner assistance through their Environmental Quality Incentives Program (EQIP) to enhance instream flows, provide stock water systems and enhance riparian habitats through fencing. This program compensated water users for not irrigating previously irrigated acres and offered cost-share for water and fence projects. Trout Unlimited provided funding to hire a local irrigation manager to assist in tracking EQIP contracts. EQIP contracts were initiated on June 21, June 28 and July 5, and terminated on September 15, 2004. The mainstem Big Hole River from Rock Creek Road to the Mouth of the North Fork (upper reach in the Big Hole Drought Management Plan) was closed for the entire angling season (May 21-Novemeber 30) due to below average instream flows in May, below average snow pack and projected instream flow forecast (Roy Kaiser, NRCS). In addition, nineteen stock water wells, two springs and two pipelines involving fifteen landowners and nine diversion systems were used as alternative stock water sources rather than instream diversions. The EQIP program's voluntary efforts were critical in maintaining instream flows from June –September. Results for the EQIP are reported in Appendix B.

Candidate Conservation Agreements with Assurances

A Candidate Conservation Agreement with Assurances is an agreement between the USFWS and any non-federal entity whereby non-federal property owners who voluntarily agree to manage their lands or waters to remove threats to species at risk of becoming threatened or endangered receive assurances against additional regulatory requirements should that species be subsequently listed under the ESA.

In 2004 FWP assessed funding and staffing needs to implement a CCAA in the Upper Big Hole Valley. A USFWS Landowner Incentive Program grant was received to fund a habitat biologist in the Upper Big Hole drainage. Responsibilities for this position are to work with landowners, agency personnel and interest groups to enhance habitat in the Upper Big Hole River that benefit Arctic grayling and sympatric aquatic species. In addition the biologist worked with landowners, USFWS, NRCS, DNRC, BHWC, TU, and BHRF to develop interest, enhance relationships and establish partners for the CCAA Program.

The goal of the CCAA program is to secure and enhance the population of fluvial (river-dwelling) Arctic grayling within the upper reaches of the Big Hole River drainage. Under the CCAA, FWP will hold an ESA Section 10(a)(1)(A) Enhancement of Survival Permit issued by the USFWS. Once this CCAA is executed, FWP will issue Certificates of Inclusion to non-federal property owners within the project area who agree to comply with all stipulations of the CCAA and develop an approved site-specific plan. Site-specific plans will be developed with each landowner by an interdisciplinary technical team made up of individuals representing FWP, USFWS, NRCS, and DNRC. Conservation measures under the agreement will: 1) Improve streamflow, 2) Improve and protect the function of streams and riparian habitats, 3) Identify and reduce or eliminate entrainment threats for grayling, and 4) Remove barriers to grayling migration.

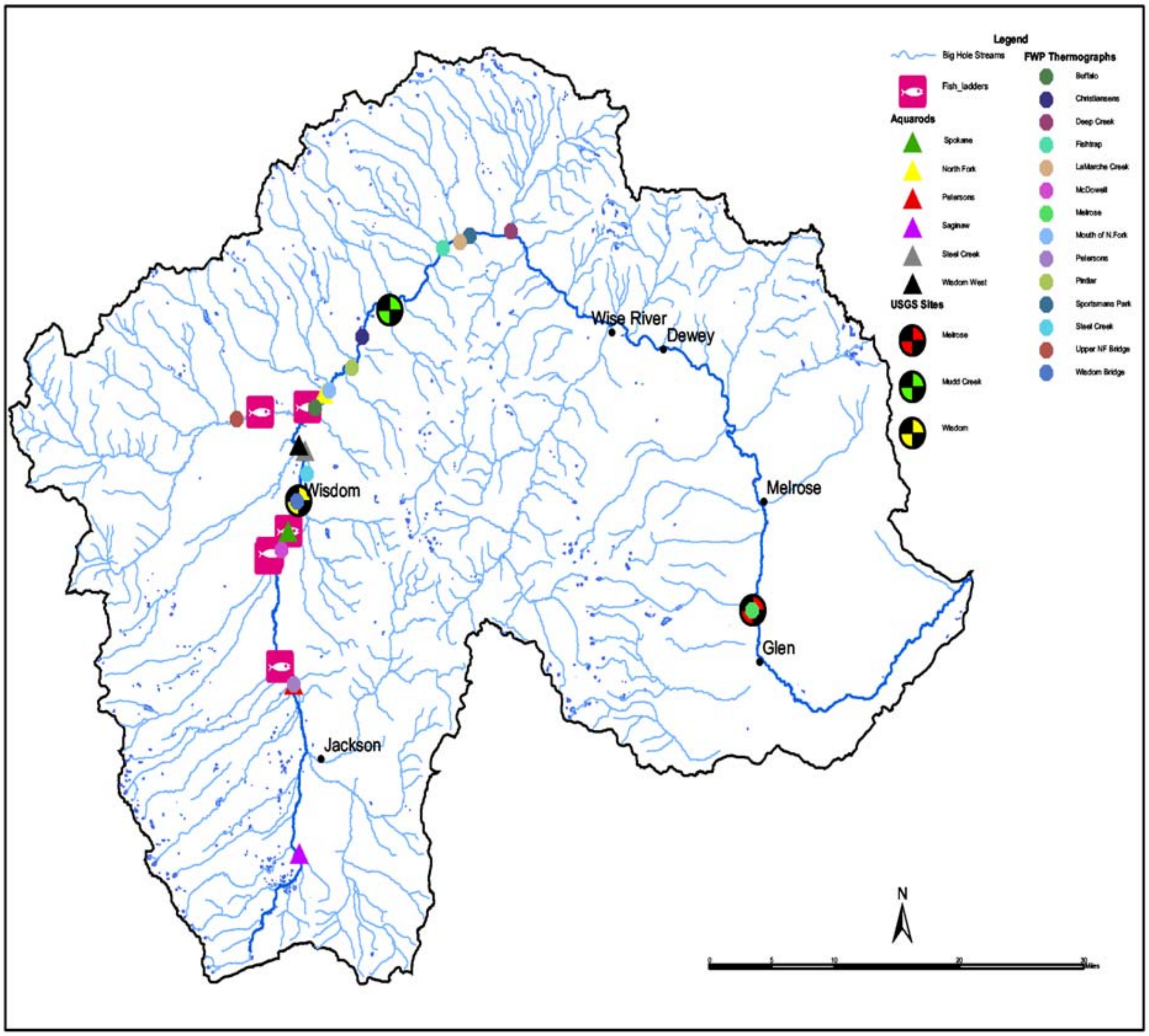

Figure 1. Map of the Big Hole River delineating locations of Aqua rods, thermographs, fish ladders, and USGS gauges.

Population Monitoring

FWP samples the Big Hole River grayling population each spring and fall to document population abundance, recruitment, age class strength, and distribution. Rainbow trout (<u>Oncorhynchus mykiss</u>), brown trout (<u>Salmo trutta</u>), brook trout

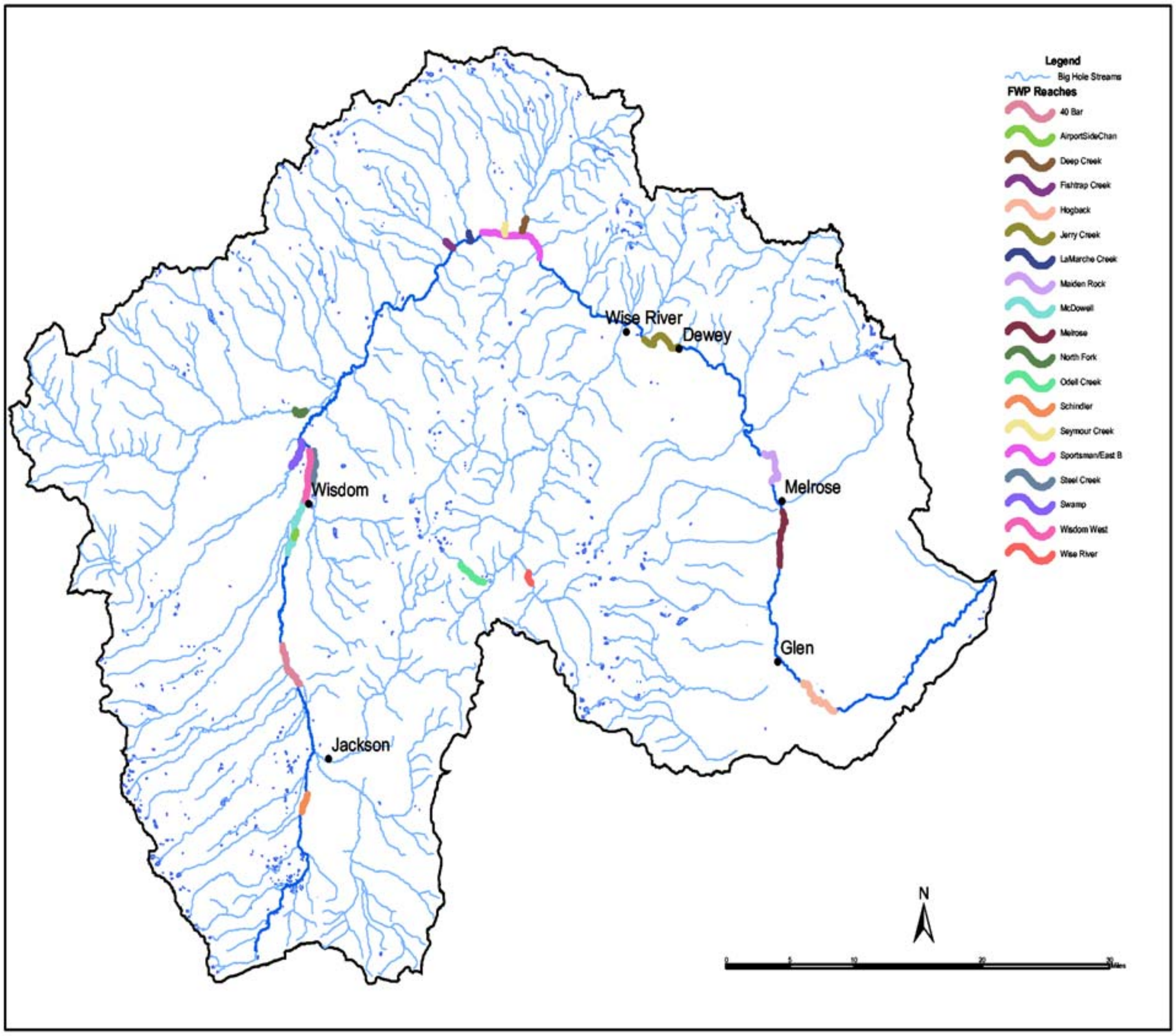

Figure 2. Map of the Big Hole River showing traditional Montana Fish, Wildlife, and Parks electrofishing reaches.

(Salvelinus fontinalis), and burbot (Lota lota) are also sampled to document densities and relative abundance.

Electrofishing sampling uses a mobile-anode DC system powered by 4,000-watt generator coupled with a Coffelt Mark XXII-M rectifying unit mounted on a drift boat or Coleman Crawdad. Target species are captured and held in a live well. Fish are anesthetized, measured (total length (± 0.1 in.) and weight (± 0.01 lb.)), fins are notched as a temporary mark, and scales are collected for aging. Grayling are tagged with a visible-implant (VI) tag in transparent adipose tissue immediately posterior to the eye.

Spring surveys assess spawning population age and movement demographics. In Spring 2004, the spawning population of grayling was surveyed by electrofishing the Upper North Fork, Buffalo - Pintlar, Pintlar-Mudd Creek sections on the mainstem Big Hole River, and the Clam Valley section on the North Fork of the Big Hole River. A single electrofishing pass was made through each section between April 20 and April 30, 2004. Mark/Recapture surveys were completed in the Maiden Rock, Melrose and Hogback sections from March 15 - April 30, 2004.

Fall population surveys in the Upper Big Hole River and tributaries provide an index of grayling abundance and recruitment. FWP surveyed between September 2 and October 22, 2004. One-pass surveys were completed on Schindler, 40 Bar, McDowell, Wisdom West, North Fork, Steel Creek, Seymour Creek, and Fishtrap Creek. Mark/recapture surveys were completed in LaMarche and Deep Creeks, Sportsman Park and Eastbank Sections (Figure 2). Another FWP crew that annually monitors trout populations in the lower river completed surveys on the Jerry Creek and Melrose Sections. Multiple mark and recapture runs were completed between September 16-October 15, 2003 (Figure 2).

Electrofishing data are entered and summarized with Fisheries Analysis 1.0.8 (Montana Fish, Wildlife and Parks 2004). Density estimates are reported as number per mile with the standard deviation at p= 0.05 presented in parentheses. Catch-per-unit-effort (CPUE) for all age classes are reported as number of fish captured per mile and used to show trends of grayling population abundance for fall surveys in traditional reaches. Length–frequency is used to summarize population age structure.

Brood Program

The Arctic grayling brood reserves at Axolotl Lake and Green Hollow Lake II provide gametes, brood stock, and young fish for reintroductions. These brood populations are monitored annually to determine abundance and collect gametes. Fyke nets and hook-and-line techniques are employed to capture grayling. According to FWP fish health protocol, all gametes or fish are tested prior to bringing them in to state hatcheries, or planting gametes/juvenile grayling into restoration streams.

Axolotl Lake Brood

The grayling brood reserve at Axolotl Lakes were first planted in 1989 and supplemented in 1993, 1997, 1999, and 2000 with progeny of the fluvial grayling brood stock derived from Big Hole River grayling and maintained at USFW Bozeman Fish Technology Center. For fish health testing, kidney samples were taken from 60 grayling on April 15, 2004 and ovarian fluids were taken from 60 spawning grayling on May 13, 2004 and tested for various pathogens.

Most captured grayling were processed as described above, marked for population estimates, and released. As grayling became gravid, they were sorted by sex and retained in separate live cars. Big Springs Trout Hatchery personnel directed gamete collection on May 13, 2004.

Eggs were stripped from female grayling, pooled, and fertilized with milt from males. After fertilization, eggs were rinsed, packed in ice, and transported to Big Springs State Fish Hatchery. Remaining grayling were released after processing. Grayling abundance in the lake was estimated with the modified Peterson model (Ricker 1958).

Green Hollow II Lake Brood

The Arctic grayling brood reserve at Green Hollow II Lake on Turner Enterprises' Flying D Ranch was first planted with age 1 fluvial Axolotl brood stock in 1998. Additional young-of-the-year (YOY) plants from the fluvial grayling broodstock located at the Bozeman Fish Technology Center were planted in 1999 and 2000.

Big Springs Trout Hatchery personnel directed gamete collection on May 11, 2004. Kidney samples were taken from 63 grayling and 40 eastern brook trout on April 7, 2004 and ovarian fluids were taken from 60 spawning grayling during gamete collection on May 11, 2004 on May 18, 2004.

To reduce the risk of BKD, as per request of the Fish Health Committee, we initiated a brook, rainbow, and rainbow/cutthroat hybrid trout removal program from Green Hollow II Lake. All fish except grayling were removed from the lake during population surveys and gamete collections efforts.

RESULTS

<u>Water Temperatures and Stream Discharge</u>

Instream temperatures are a result of air temperature, photoperiod, riparian health, channel morphology and stream flow. Maximum instream temperatures typically peak in July and decrease in August with cooler nighttime temperatures and decreasing photo period. Maximum temperatures in 2004 occurred on July 16 and July 17 for all thermograph sites (Figure 3). Water temperatures rose above 70°F at all mainstem-monitoring stations during the summer. Temperatures at this level for prolonged periods are considered stressful to salmonids. Mainstem sites with high width to depth ratios and little woody riparian vegetation exceeded upper incipient lethal temperatures (77°F) for Arctic grayling (Lohr et. al. 1996). Some tributaries were cooler and provided thermal refugia. LaMarche and Fishtrap Creeks were noticeably cooler than adjacent mainstem sections and other tributaries (Steel Creek and Deep Creek) (Figure 3).

The snowpack in the Big Hole basin was 74% of the Period of Record (POR) on April 1 2004. Above average air temperatures in March accelerated lowland valley snowmelt and depleted soil moisture resulting in earlier irrigation and low instream flows. Lowest mean daily flow at Wisdom was 7.1 cfs on May 11 and the highest mean daily flow was 362 cfs on July 1, 2004. Precipitation from May-September was approximately 4 inches above the long-term mean at Wisdom, however, due to the poor snowpack, cumulative drought conditions and extremely poor early spring precipitation, stream flows were 29% of the POR from April –October. April flows were 23%, May 10%, June 16%, July 60%, August 55%, September 162 %, and October 113% of the POR (Figure 4). Flows at the USGS Mudd Creek and Melrose stations were 65% and 44% of POR means respectively. Instream flows in other mainstem reaches and tributaries, although still below long term means, had relatively better flows than the Wisdom reach (Appendix B). Summer precipitation, implementation of the EQIP program and volunteer conservation efforts improved instream flows from forecasted lows and compared to 2000-2003 water years (especially in July-September) (Figure 4).

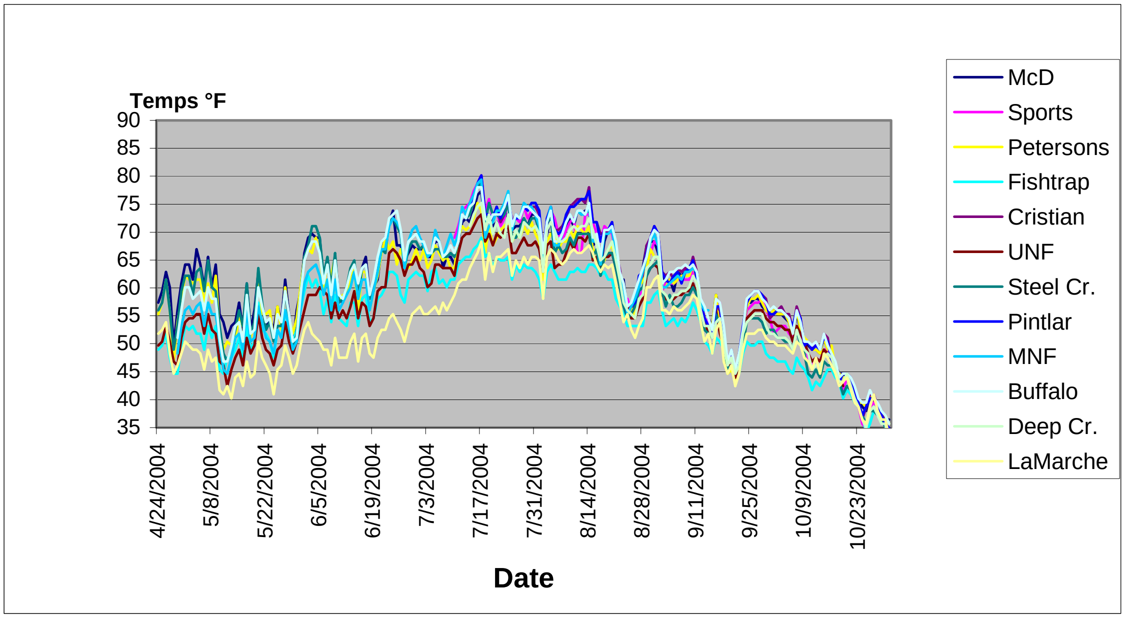

Figure 3. Big Hole River and tributary instream temperatures from MFWP Hobo temp-loggers on the Big Hole River, Montana in 2004.

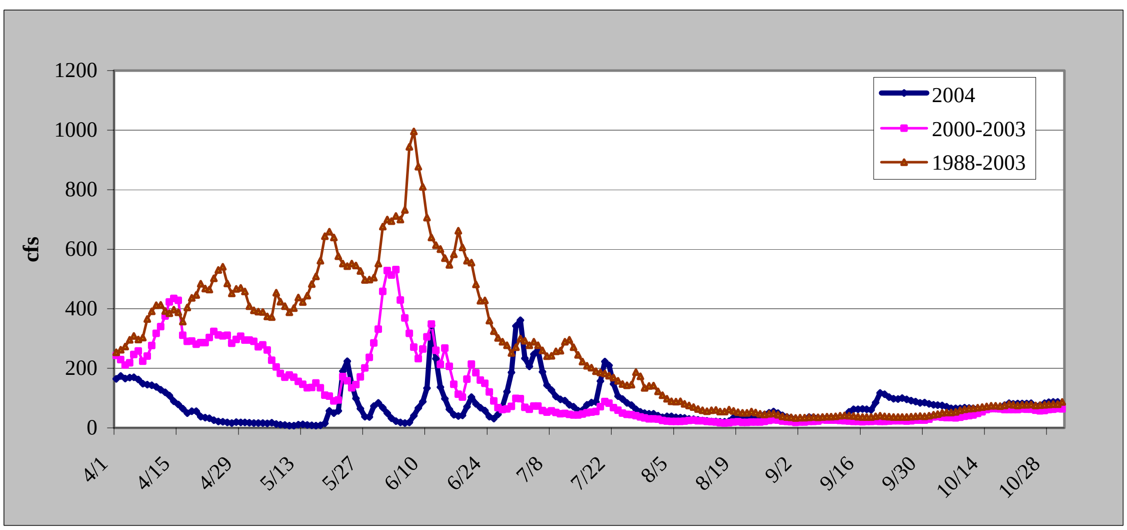

Figure 4. Average daily flows at the USGS Wisdom Gage on the Big Hole River, Montana, from1988-2004 and Period-of-Record (POR).

Population Monitoring

Spring spawning surveys

We captured 12 age 1 and older grayling during spawning surveys. Based on length-frequency analysis, 85% of captured grayling were age 3 and older, and 15% were age 1 and age 2 fish. Surveys were discontinued in order to implement conservation efforts to maintain instream flows.

Fall population monitoring

We captured 265 grayling in fall electrofishing surveys of which 134 (53%) were YOY (Figure 7). The strong YOY age class from 2003 can be seen as age 1 grayling (8-9 inches) in the fall of 2004 (Figure 7). These yearling grayling were captured in survey reaches from Melrose upstream to McDowell. The overall age class balance stability improved from 2003 to 2004 (Figure 7) especially age 1 and age 2 grayling (8-11 inches). Tributaries provide habitat and conditions favorable to, and utilized by all age classes of grayling. (Figure 8, 9). In LaMarche Creek we estimated 89 (SD=32) grayling per mile and on Deep Creek we estimated 27 (SD=6) per mile for all age classes. Tributaries also provide favorable conditions to other species. Tributaries (Fishtrap, LaMarche and Deep Creek) had among the highest catch rates of grayling as well as brook trout, rainbow trout, and burbot. The Schindler reach in the mainstem Big Hole had the highest Catch Per Unit Effort (CPUE) of brook trout for mainstem reaches. (Figure 9). Rainbow trout and brown trout are more abundant in downstream reaches and tributaries (Deep Creek, Eastbank).

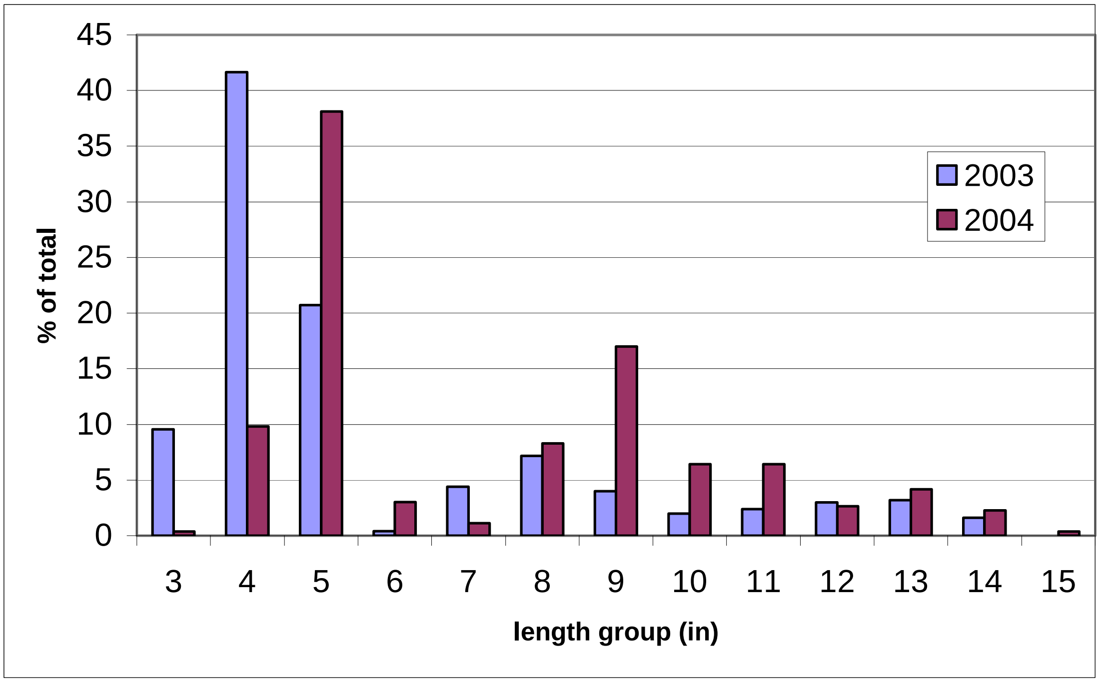

Figure 7. Length-Frequency histogram comparing 2003 (n=502) and 2004 (n=265) for Arctic grayling from MFWP electrofishing surveys on the Big Hole River, Montana Fall 2004.

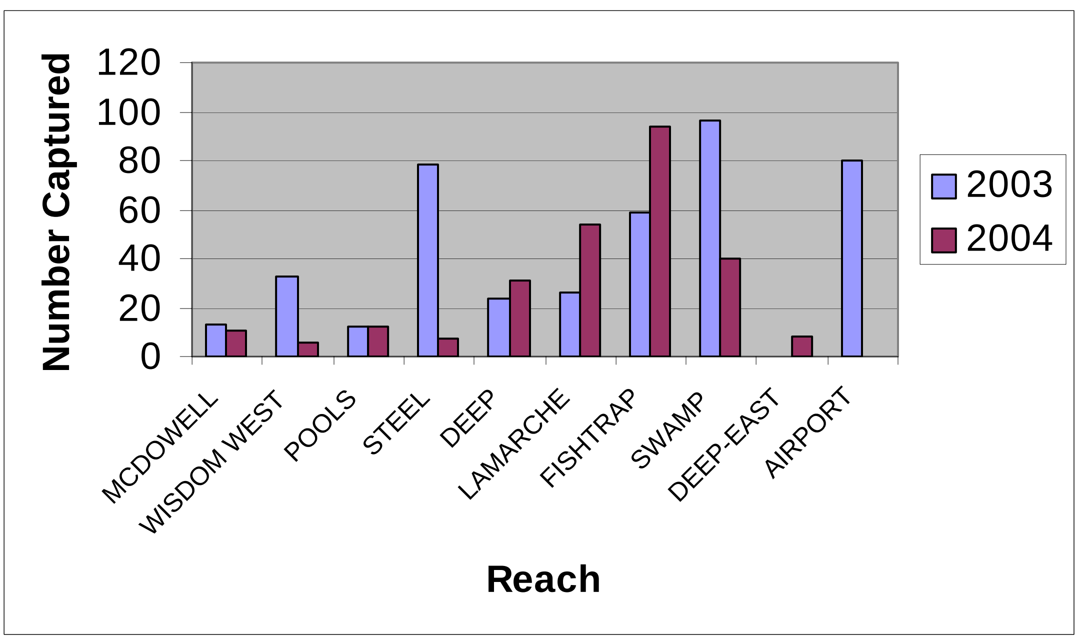

Figure 8. The number of Arctic grayling captured by reach during Fall 2003 and Fall 2004 MFWP electrofishing surveys in the Big Hole River, Montana.

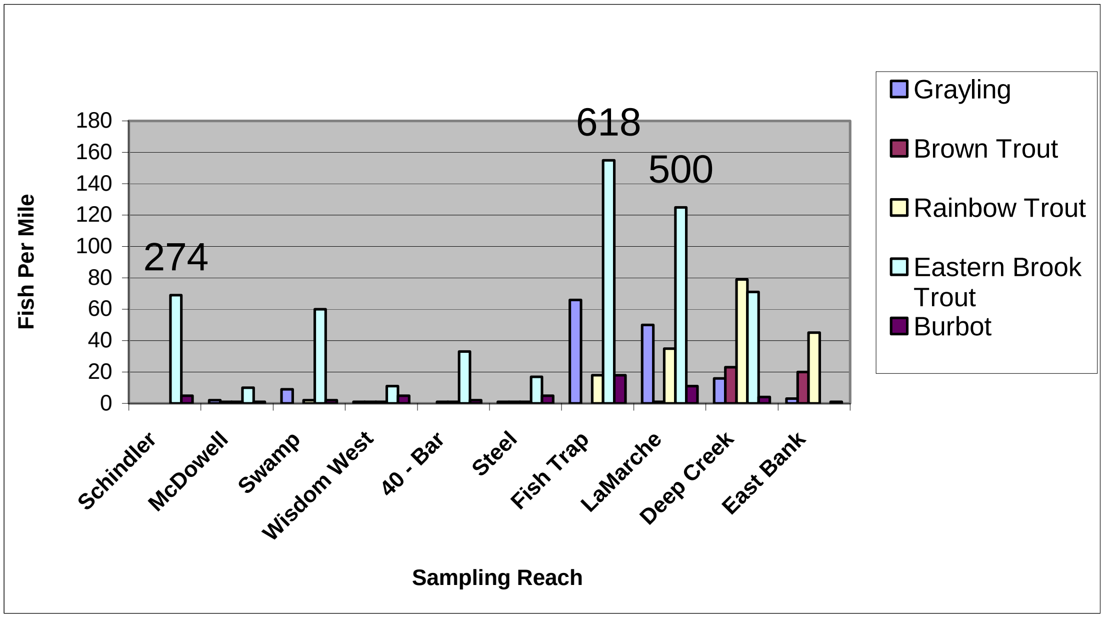

Figure 9. Catch Per Unit Effort (fish/mile) of Arctic grayling, brown trout, rainbow trout, eastern brook trout, and burbot for MFWP Big Hole River electrofishing reaches in fall 2004. Actual number of eastern brook trout for Schindler, Fishtrap and LaMarche Creek are indicated numerically.

Brood Program

Axolotl Lakes Brood

We captured 793 Arctic grayling for gamete collection and population estimates. All samples submitted for disease analysis tested negative for pathogens. Grayling captured were ages 4, 6 and 7. Average length for all grayling was 10.98 inches. Mark-recapture analysis estimated 1275 (±60) grayling in the Axolotl Brood Lake population. On May 13, we spawned 186 females and collected approximately 300,000 eggs. Due to increasing presence of larger, older fish, fecundity increased dramatically from 419 eggs per female in 2002 to 1,338 eggs per female in 2003 to 1,615 eggs per female in 2004. Fertilized eggs were taken to Big Springs State Fish Hatchery for development to eye-up.

On May 27, 20,000 eyed eggs were taken to the North Fork of the Sun River and put into RSIs. The remaining eggs were transported to Bluewater State Fish Hatchery to be raised to yearlings for restoration efforts in 2005. A total 50,000 grayling were available for restoration efforts for spring 2005.

Green Hollow II Brood

We collected 1,012 grayling for gamete collection and population estimates. All grayling and trout samples submitted for disease analysis tested negative for pathogens. Grayling captured were age 4 and age 5, with a mean length of 11.02 inches. Mark/recapture analysis estimated 1,892 (±126) grayling in the brood lake. On May 11, we spawned 42 females with 47 males and collected 67,000 eggs. Fecundity averaged 1,595 eggs per female. On May 20, 40,320 eyed eggs were transported to the Upper Ruby River and placed in RSI's.

DISCUSSION

Despite above average summer precipitation in 2004, the Big Hole River suffered from drought conditions for the sixth consecutive year. Voluntary conservation measures implemented by landowners were invaluable in improving stream flows. In addition, the NRCS EQIP program and summer precipitation improved flow conditions from forecasted low levels. These efforts resulted in improved age class balance and encouraging survival of YOY grayling in 2003 as yearlings in 2004. While instream flow conditions were not optimal during spawning in some reaches, YOY were found in the mainstem in low abundance and in greater abundance in the tributaries.

CPUE was higher in tributaries than mainstem reaches. Tributary flow, temperature, and riparian conditions provide suitable grayling habitat for all age classes.

CPUE is also relatively higher in tributaries for other species reiterating the favorable channel morphology and riparian conditions. This is further evidence that Conservation efforts that address channel morphology and riparian health are equally as important as improved instream flow dynamics.

In 2005, efforts will focus on initiating the CCAA Program to implement conservation efforts on private properties that address poor instream flow dynamics, riparian health, fish passage and diversion entrainment. FWP and cooperating agencies will work to complete the CCAA agreements and develop site-specific conservation plans with private landowners.

Efforts to establish additional populations of fluvial grayling will continue. In 2005, Grayling plants will be made on the Ruby River and Missouri Headwaters restoration reaches. Remote site incubators will be used in the North Fork of the Sun River and in the Ruby River to produce grayling that have developed under selective mechanisms of the stream. Montana Fish, Wildlife and Parks and the Fluvial Grayling Workgroup will continue to work with agencies, landowners, watershed and interest groups to conserve, protect, and enhance fluvial Arctic grayling in Montana.

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APPENDIX A

Reintroduction Efforts

The long-term restoration goal for Montana Arctic grayling is to establish five populations (including the Big Hole) within historic drainages by 2020. Restoration efforts were initiated in 1997 in the Upper Ruby River and have expanded to the North and South forks of the Sun, the lower Beaverhead and the Missouri River Headwaters since 1999. Due to the on-going drought and limited resources, the FGW in 2002 recommended focusing reintroduction efforts on the Upper Ruby River and to continue other efforts as funding, workload and resources allowed. In 2004, FWP continued to assess limiting factors and survival of previous plants or continued to plant grayling or use remote stream incubators in the North of the Sun River, and the Missouri River Headwaters and the Upper Ruby River.

Sun River

A total of 34,000 grayling were planted in the forks of the Sun River from 1999-2001. Grayling planted in 1999-2001were ages 4-6 in 2004. To assess population demographics, distribution, survival and natural reproduction, on June 10-11 2004 we electrofished at the confluence of the North and South Forks and set 4 trapnets in Gibson Reservoir (Table 1). A total of 11 grayling were captured, ranging from 10.7-12.2 inches. Grayling captured were in spawning condition. Numbers of grayling captured have decreased since 2001 (Table 3) with similar sampling efforts. Total lengths of grayling captured in 2004 indicate grayling may be limited in growth by the Gibson/Sun

River environment as similar aged grayling in the Big Hole River obtain maximum lengths at age 4-6 of 13-15 inches. No small juvenile grayling were found and there was no evidence of natural reproduction.

From May 24-26, 2004 ten RSI sites were constructed at the mouth of Biggs and Headwater Creek near Gates Park on the North Fork of the Sun River. On May 27, eyed eggs that were collected from the Axolotl brood population and incubated at Big Spring State Fish Hatchery were transported to the RSI's. Each incubator received 1,200 eggs for a total of 12,000 eggs. Percent emergence of swim up fry was estimated at 90% resulting in approximately 10,800 fry entering into the system. Plans for 2005 are to expand RSI efforts utilizing 30 incubators and developing 35,000-40,000 eyed eggs to swim up fry.

Table 1: Montana Fish, Wildlife and Parks trapping and electrofishing effort with number of grayling captured and size range in Gibson reservoir and at the North and South forks of the Sun River from 2001-2004

Year	Number traps/nets	Number Grayling	Size Range	Sun Forks # grayling	Effort Seconds	Size Range
2001	3	67	8.1-11.7	55	2,764	7.9-11.9
2002	6	159	8.6-12.1	19	5,876	8.6-11.2
2003	5	17	9.4-11.7	9	2,400	10.3-12.3
2004	4	3	10.7-11.7	8	3,424	10.7-12.2

Missouri River Headwater

The Missouri River Headwater has been stocked with grayling on an annual basis from 2000-2003. In 2004, approximately 40,000 yearling grayling averaging 7.8 inches were planted in the Madison and Gallatin Rivers. Grayling originated from gametes collected from the Axolotl brood population and were raised at the Bluewater State Fish

Hatchery. On the Madison River, 20,095 grayling were planted near the Greycliff and Milwaukee Bridge Fishing Access Sites on April 22 and May 2, 2004. On the Gallatin River, 20,001 grayling were planted on May 3-4, 2004 near the town of Logan. Jet boat electrofishing surveys were completed on the lower Gallatin, lower Madison and the Missouri River near Trident on November 8 and on the Greycliff Section on the Madison River on November 15, 2004. No grayling were captured in the Missouri River and one grayling was captured on the Madison River downstream from the confluence with the Jefferson River. Eleven grayling were captured in the lower ¼ mile of the Gallatin River. On the Greycliff Section two grayling were captured. Grayling sizes range from 9.9-11.4 inches.

Ruby River

We planted 28,000 age 1 grayling raised in the Bluewater State Fish Hatchery and 1,500 age 2 grayling raised at the Bozeman Fish Technology Center in the Upper Ruby River in 2004. Grayling were planted at 8 locations upstream of Vigilante Guard Station (Figure 10) between May 10-May 18, 2004.

Spring electrofishing surveys were completed in 12 reaches and fall surveys were completed in 14 reaches to assess previous plant survival, distribution, abundance and population demographics. Spring and fall surveys found highest abundance of grayling in the Vigilante reach (Figure 1, Figure 2). Grayling captured in the upper reaches were a combination of planted grayling and grayling produced from RSIs. Few grayling were found in the lower reaches downstream of the Canyon Section. This may be due to domination of downstream sections by brown trout, with no brown trout found upstream of the Canyon Section. Rainbow/cutthroat trout abundance is highest in the Canyon

Section and decreases in up and downstream reaches.

Grayling produced in RSI’s in 2003 survived over winter to age 1 and were captured in spring of 2004 surveys at total lenghts ranging from 2.5-5.5 inches (Figure 3) and in fall at lengths ranging from 7-8 inches. Similarly, grayling produced in RSI’s in spring of 2004 were captured in fall 2004 surveys with lengths ranging from of 2.5-4.5 inches. Yearling grayling raised in state hatcheries planted in 2003 and 2004 were captured as age 1 and age 2 grayling ranging from 8.5- 12.5 inches in length (Figure 4).

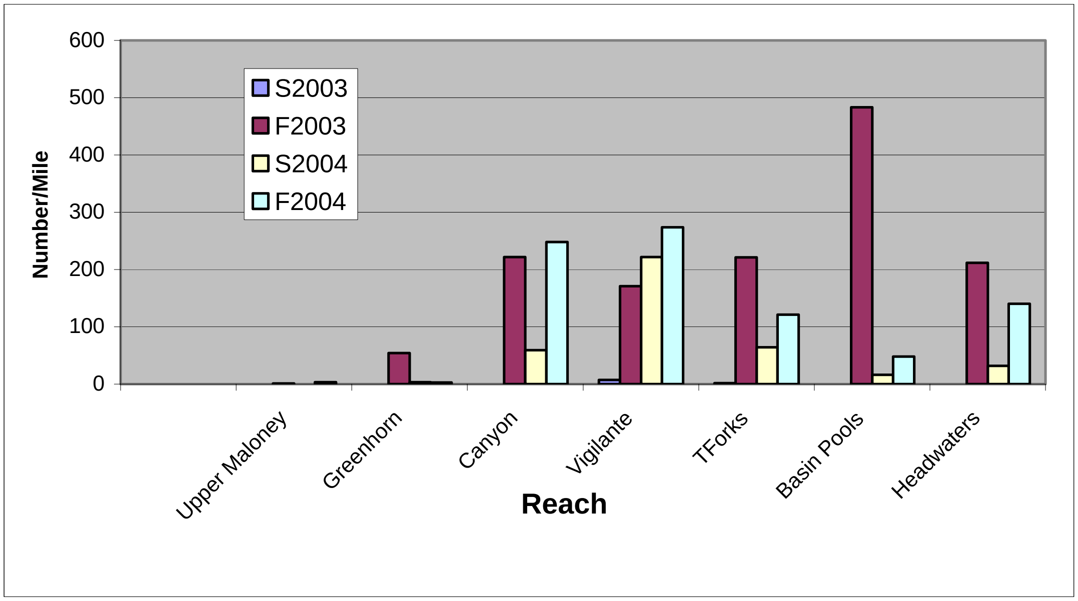


Figure 1. Catch Per Unit Effort (fish/mile) for Arctic grayling by reach from MFWP electrofishing surveys from 2002-2004 in the Upper Ruby River, Montana.

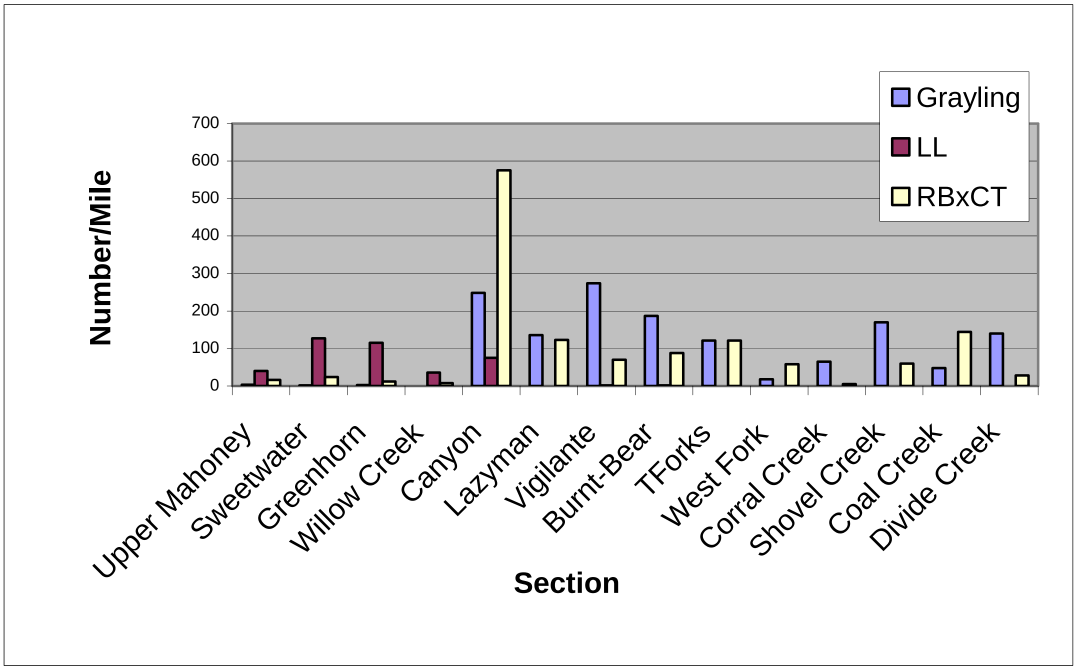


Figure 2. Catch Per Unit Effort (fish/mile) for Arctic grayling, brown trout (LL), and rainbow/cutthroat trout hybrids (RBxCT) by reach for MFWP electrofishing surveys in fall 2004 in the Upper Ruby River, Montana.

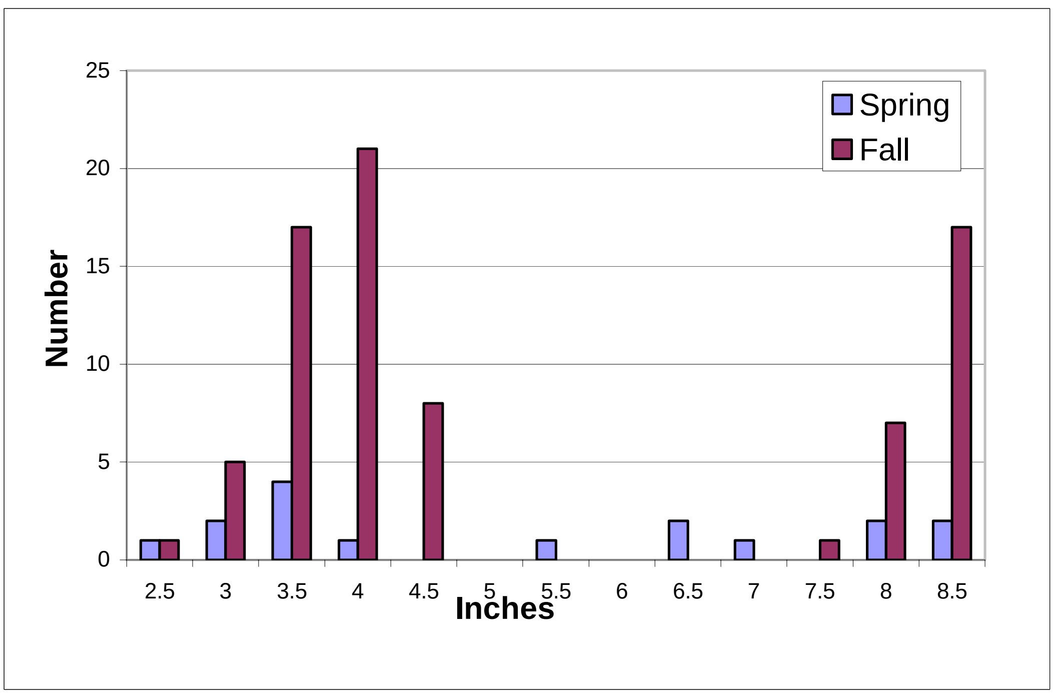


Figure 3. Length-Frequency Histogram for Arctic grayling captured by MFWP electrofishing surveys in 2004 Spring (n=16) and Fall (n=77) for sizes 2.5-8.5 inches in the Upper Ruby River, Montana.

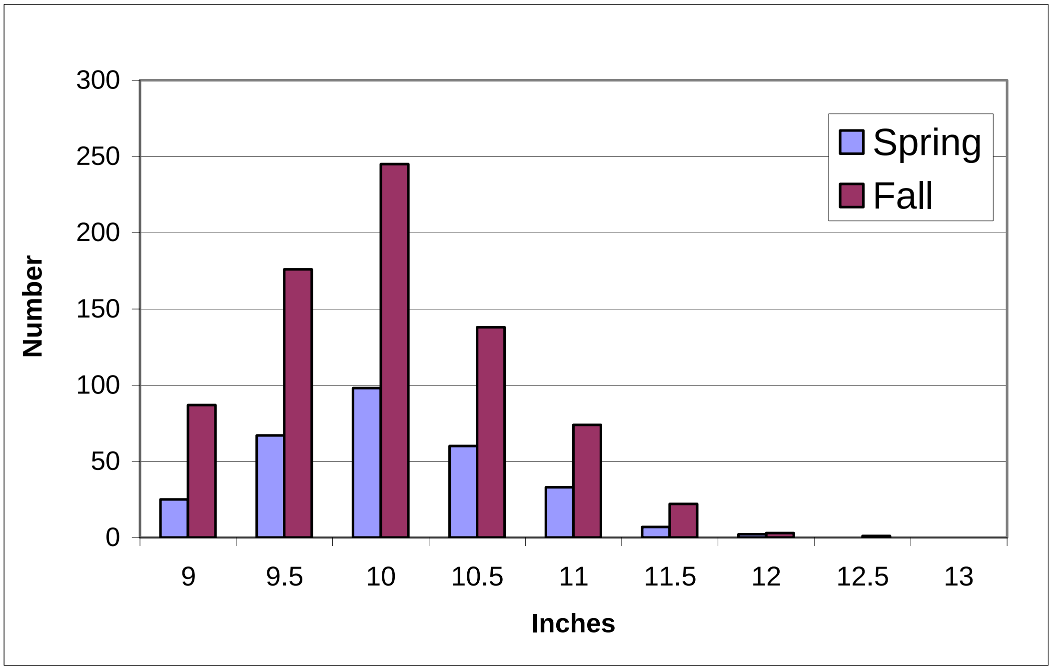


Figure 4. Length-Frequency Histogram for Arctic grayling captured by MFWP electrofishing surveys in 2004 Spring (n=292) and Fall (n=746) for sizes 9.0-13.0 inches in the Upper Ruby River, Montana.

APPENDIX B

Upper Big Hole River 2004 Water Management

Mike Roberts
Montana Department of
Natural Resources and Conservation
February 2005

Introduction

The sustainability of agriculture, recreation, and fisheries is a critical concern of water users and stakeholders in the upper Big Hole River. Water availability is the key component to maintaining that sustainability. The upper Big Hole River basin is one of the largest hay and cattle producing areas in Montana (Figure 1). It is also home to the fluvial Arctic Grayling, a candidate species for listing under the Endangered Species Act. In the spring of 2004, low snow pack conditions, cumulative soil moisture deficits, and above average temperatures in March, threatened to continue drought conditions for a sixth consecutive year. When streamflows in the Big Hole River near Wisdom fell below 10 cfs in early May, irrigators, the Big Hole Watershed Committee, and state and federal agencies met to discuss approaches for dealing with impending drought and a potential emergency listing of the grayling.

This report will summarize the water saving efforts put forth by irrigators, state and federal agencies, and the Big Hole Watershed Committee in 2004.

Background

During the winter of 2004, snowpack in the Big Hole basin accumulated at a slightly below normal pace through February. By March, unseasonably warm weather melted the low to mid-elevation snow in the upper basin facilitating some early runoff. Concerns for the impending drought caused ranchers to begin irrigating in early to mid April, as much as two to three weeks earlier than normal for some operations. By early May, flows in the Big Hole River at Wisdom were less than 10 cfs at a time when flows are typically between 300 and 600 cfs (Figure 2.). By the end of the third week of June the remainder of the high elevation snow had melted.

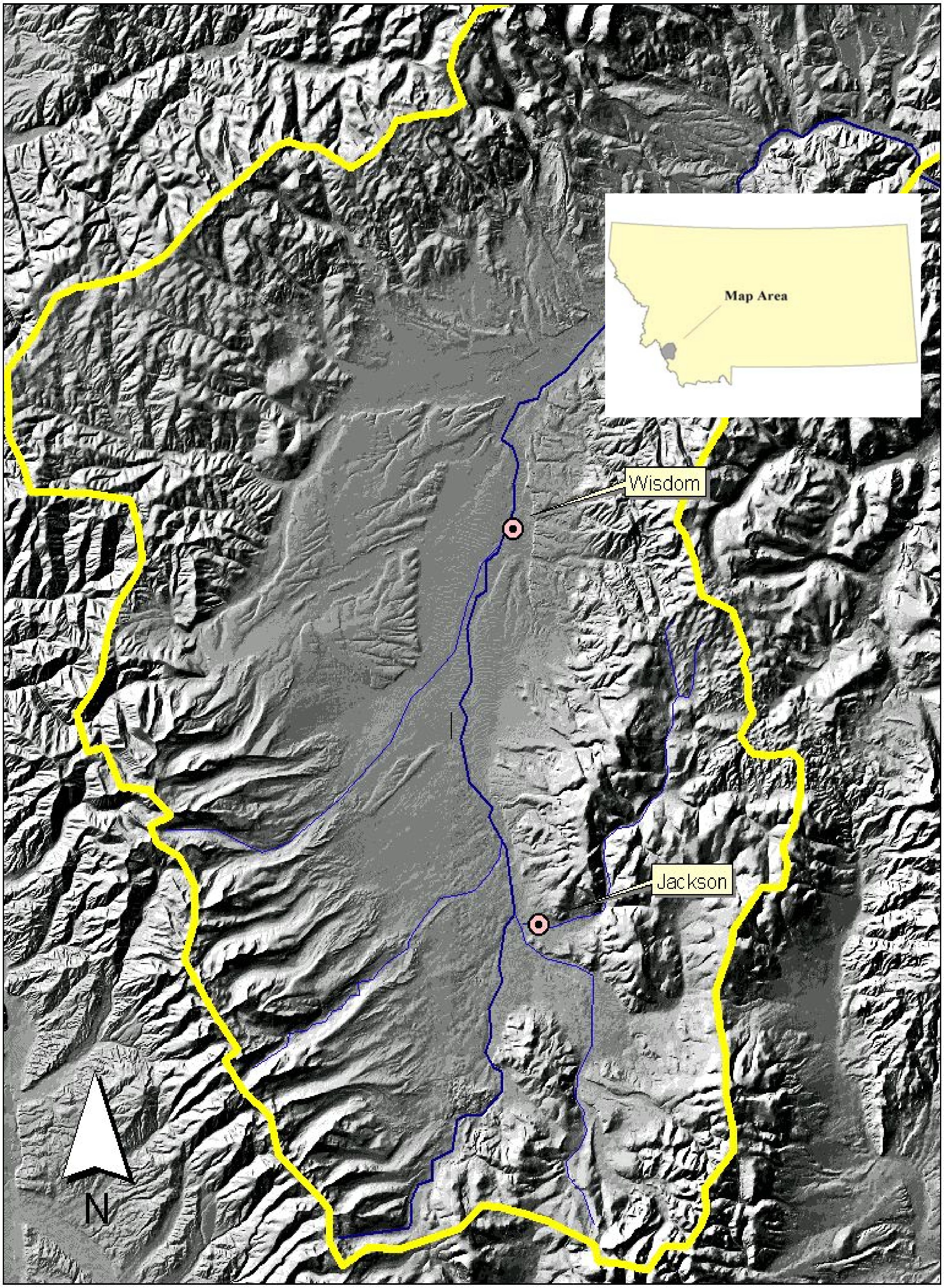
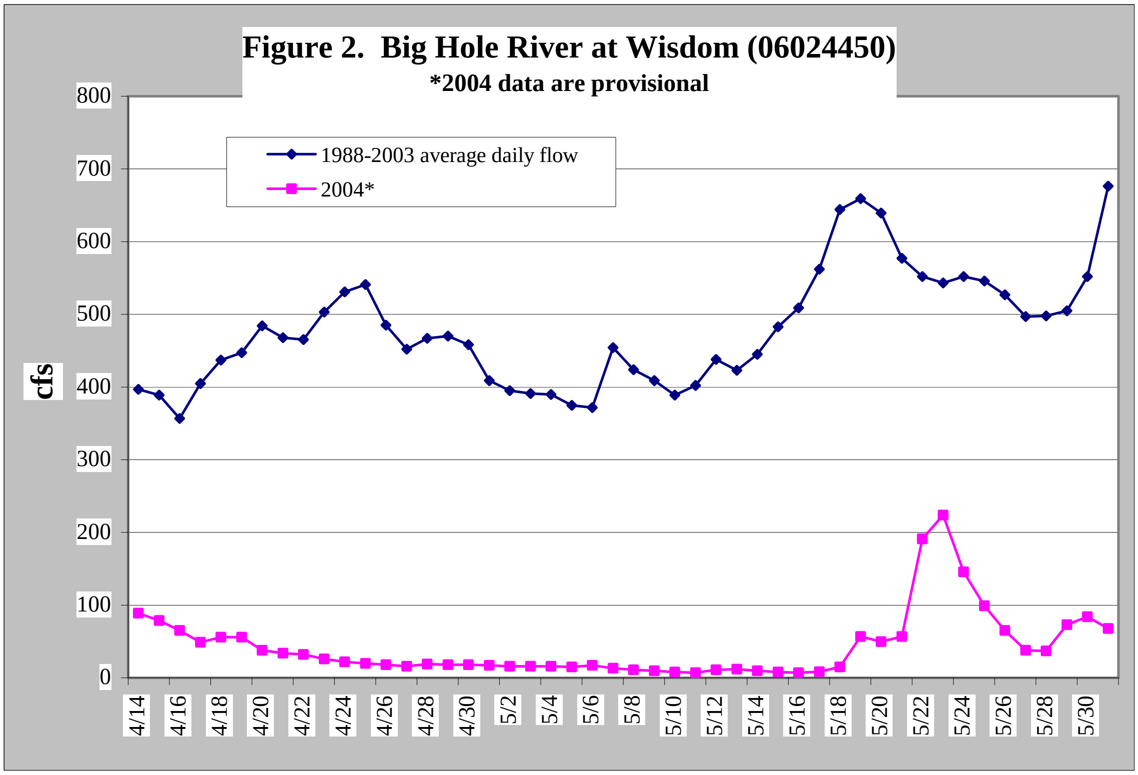


Figure 1. Map of Upper Big Hole River Basin.



Dramatically low streamflow conditions at the Wisdom gage in May and the threat of emergency endangered species listing of the fluvial Arctic Grayling prompted a series of public meetings amongst water users and stakeholders in the upper basin. The purpose of the public meetings was to inform the water users on the status of water availability, status of the potential emergency listing of the grayling, and to attempt to develop a plan to address impending low flow conditions. The Natural Resource Conservation Service (NRCS) offered to provide financial assistance to irrigators who were willing to participate in an emergency plan that would pay them to not irrigate certain parcels of land within the affected area. The NRCS also offered to fund ground water extraction for stock tanks in lieu of diverting river and tributary water used solely for livestock. In addition, fencing for managing riparian exclosures and/or riparian pastures was offered to interested ranchers.

EQIP Plan

Using funds appropriated through the Environmental Quality Incentive Program (EQIP), the NRCS accepted applications from interested parties between June 7th and the 16th. Conservation plans were written for 16 water users and included the following:

1. 14,491 acres of deferred irrigation.
2. 12 stock watering facilities.

(note: no fencing was contracted)

Approximately half of the nearly 15,000 acres of deferred irrigation was for grass hay production, which typically ends its season in early July. The other half was for pasture grass irrigation, which normally diverts water all summer. A total of 49 headgates were either fully or partially shut down when the project was implemented (Figure 3). A three-phase approach was employed with headgates either completely or partially closed on June 21, June 28, or July 5.

Five priority areas were delineated for landowner participation. These areas, listed below, were designed to prioritize and target those areas that would provide the most benefit to streamflows and fisheries in the upper river.

<u>Priority 1</u> - Mainstem Big Hole River between Big Swamp Creek and Wisdom Bridge

<u>Priority 2</u> - Tributaries of the Mainstem between Big Swamp Creek and Wisdom Bridge

<u>Priority 3</u> - Mainstem Big Hole River above Big Swamp Creek Road

<u>Priority 4</u> - Tributaries to the mainstem above Big Swamp Creek Road

<u>Priority 5</u> - The following tributaries below Wisdom Bridge: Fishtrap Creek, LaMarche Creek, Deep Creek, Swamp Creek, and Steel Creek.

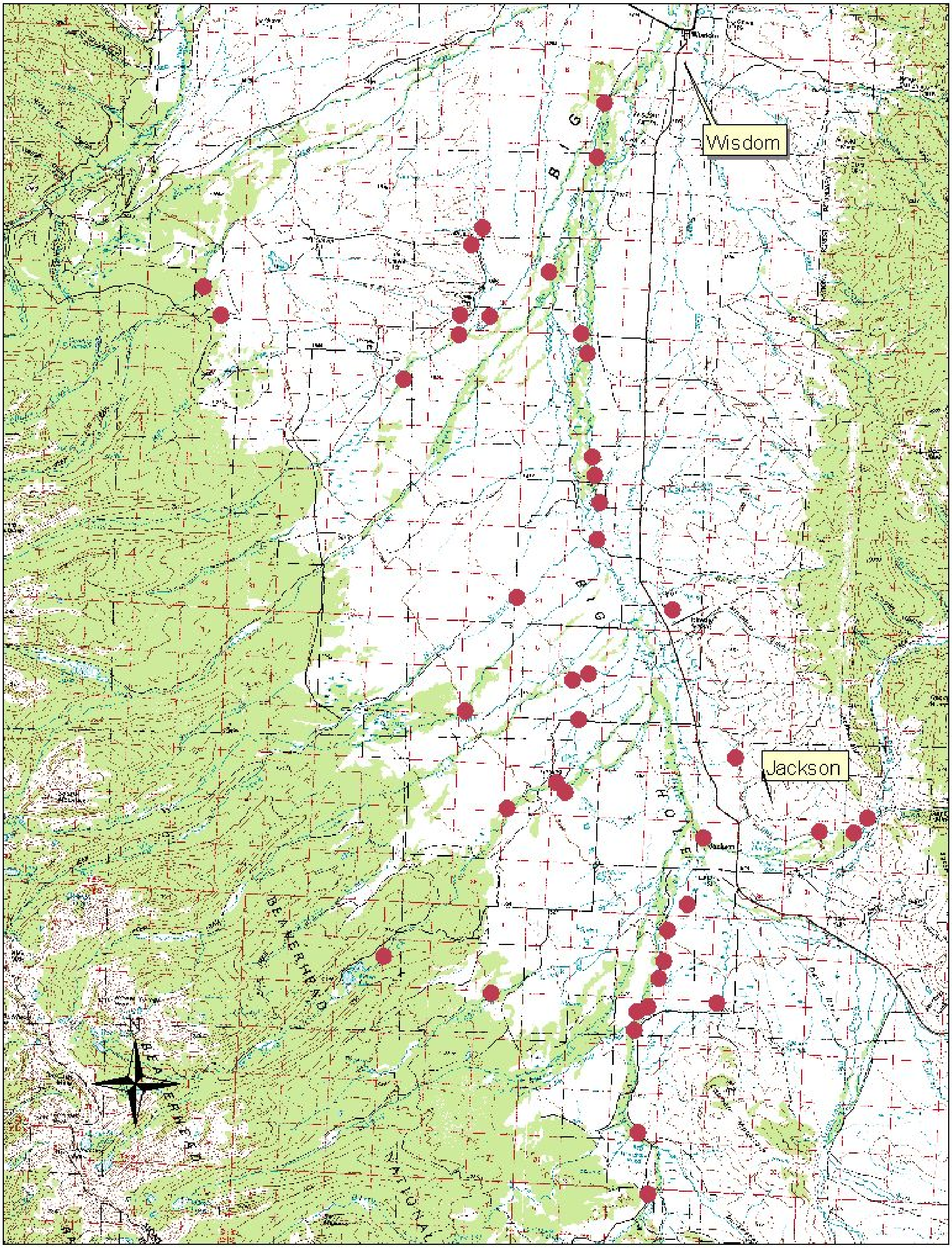


Figure 3. Distribution of headgates affected by EQIP Plan.

In addition to the irrigators enrolled in the plan, several public and private entities participated in the efforts to implement the EQIP emergency action plan.

1. NRCS
2. United States Fish & Wildlife Service
3. Montana Department Fish, Wildlife, and Parks
4. Montana Department Natural Resources and Conservation
5. Montana Chapter of Trout Unlimited
6. Big Hole Watershed Committee
7. Big Hole River Foundation

The goal of the emergency plan was to provide ranchers compensation for deferring irrigation to specific parcels of land and therefore potentially increasing flows in the Big Hole River. Increasing flows in the Big Hole River, it was anticipated, would improve conditions for the grayling and potentially decrease the likelihood off an emergency listing.

In addition to the 16 participants in the NRCS plan, several landowners voluntarily participated in the program (i.e. without financial compensation) either by giving up water similar to those enrolled in the plan or by allowing “conserved” water to bypass their headgates.

Implementation and Monitoring

To ensure the NRCS-EQIP emergency plan was properly implemented, an inter-agency team of hydrologists and biologists were assigned to carryout the conservation plans as prescribed for each participant by the NRCS. In addition, a ditch rider contracted by the Big Hole River Foundation with funding provided by the Montana

Chapter of Trout Unlimited, assisted with daily monitoring of streamflows and conservation plans. To implement the plan, flows were reduced or completely shut off at all enrolled points of diversion. At most of the diversions, a team member was present to assist the landowner with the reduction, as well as to quantify ditch flows to be left in the designated stream. In a few cases, landowners shut off their diversions without the accompaniment of a team member, and therefore quantification of ditch flows were either estimated or relayed through water measurement device readings by the landowner.

Real-time monitoring of river status was provided by the United States Geological Survey (USGS) Wisdom streamflow gage. This gage represents the key monitoring point for assessing flow conditions in the upper basin. The gage is also located in the most dewatered reach in the upper river. The period of record at this gage site is 17 years.

Flow volume for 13 of the last 17 years were less than normal when compared to the long-term gage downstream at Melrose.

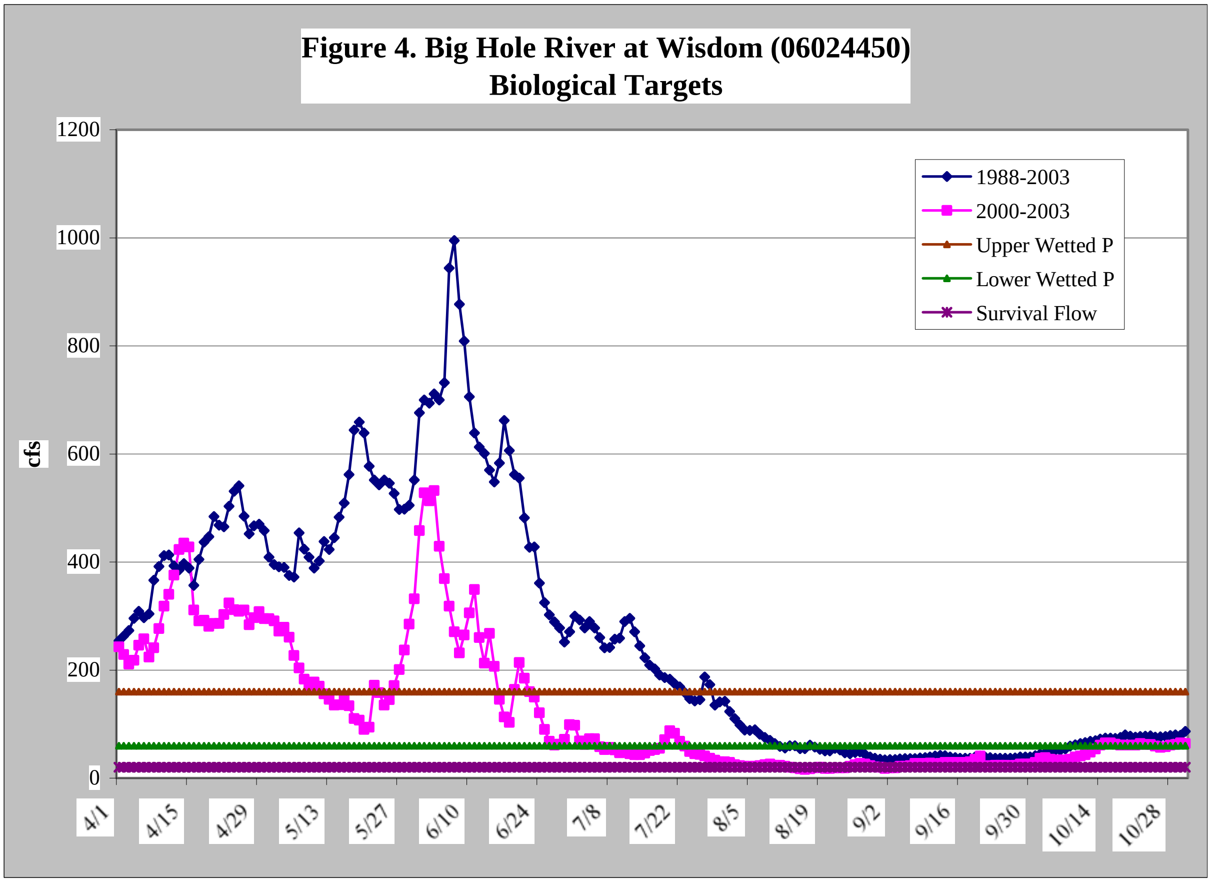
River flow levels at the Wisdom gage are monitored for biological needs and for drought plan implementation by FWP and the Big Hole Watershed Committee (Table 1).

Table 1. Flow goals for Big Hole River at Wisdom.

Flow Level (cfs)	Description	Method
160	upper inflection point	FWP Wetted Perimeter Method
60	lower inflection point, initiation of drought plan	FWP Wetted Perimeter Method
40	voluntary closures begin	Big Hole Watershed Committee Drought Plan
20	river closed to fishing	Big Hole Watershed Committee Drought Plan

Mid-July thru September flows at the Wisdom gage typically fall below the flow level criteria listed above and in recent years have averaged at or less than 20 cfs in August and September (Figure 4). While the goal of the emergency plan was to increase river flows as much as possible, a secondary target was to keep flows above the minimum survival flows of 20 cfs. In addition to the Wisdom streamflow gage, DNRC had seven established continuous streamflow stations located in the upper basin. Three of those sites provide hourly and daily flows in the reach above Wisdom.

For additional tracking of flows associated with this project, a network of staff gages were installed and rated at strategic locations along the river above (Figure 5).



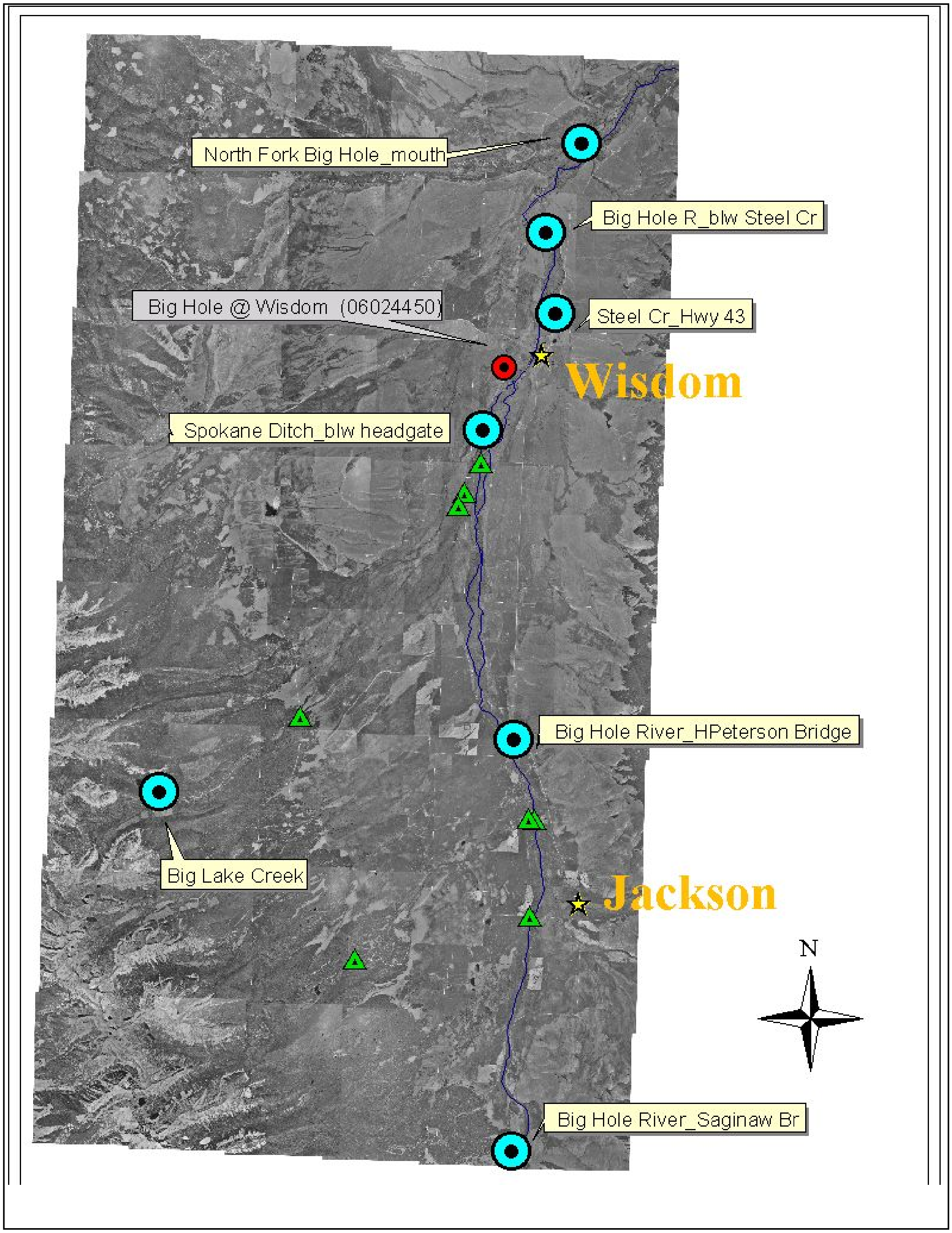


Figure 5. Gaging locations

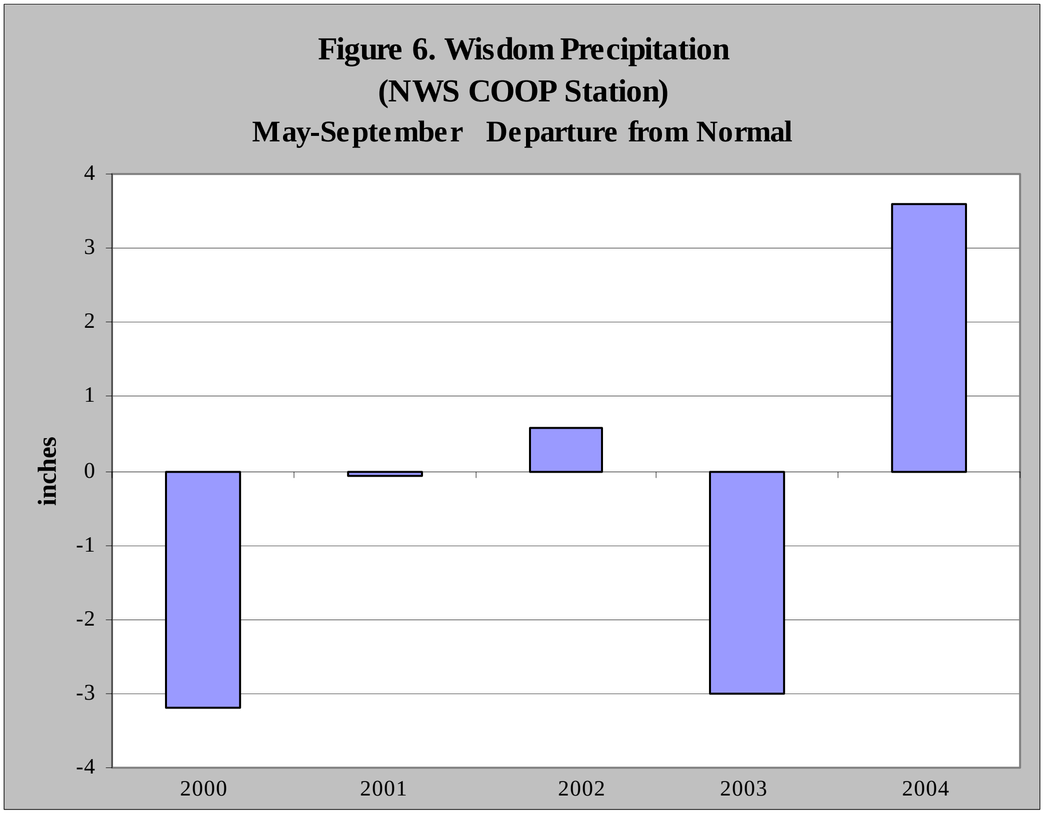
Concurrent with and following the flow reductions implemented to comply with all the EQIP contracts, monitoring of tributary and river flows was conducted to attempt to quantify contributions from this project. As well, periodic inspections of site operations were made to ensure compliance with each individuals EQIP contract and to address concerns voiced by some irrigators in the upper basin.

Results of EQIP Plan

An assessment of streamflow gains due to the implementation of the EQIP emergency plan was based on tracking flows at the various locations in the watershed including the Wisdom gage. Precipitation played a major water contribution role to the project area during the summer months of 2004. While the above normal amount of precipitation contributed positively to streamflows and hay and grass production, it did confound efforts to quantify direct contributions resulting from the EQIP emergency plan.

Precipitation

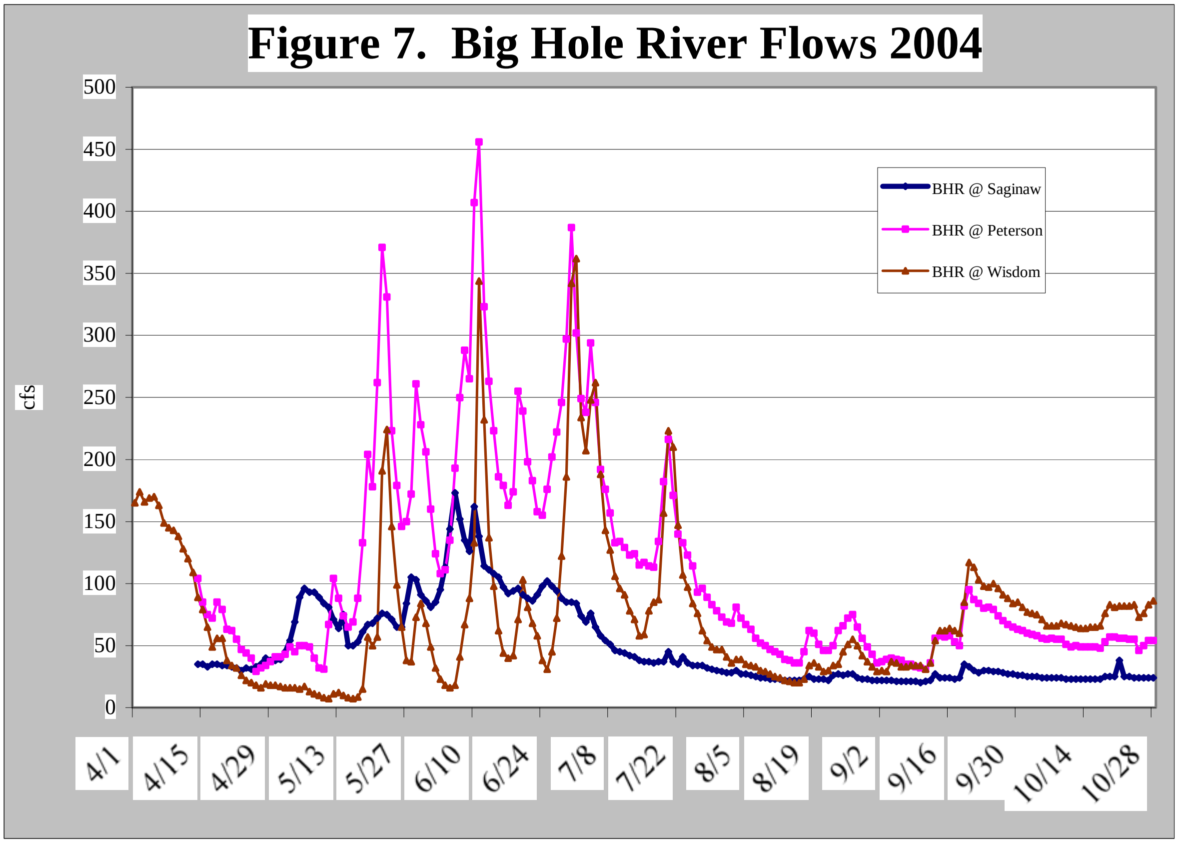
Normal annual valley precipitation for the upper Big Hole at Wisdom and Jackson is approximately 12 inches with 6.75 of those inches falling between May and September. During the summer of 2004, 10.3 inches of rain fell at Wisdom, nearly four inches above normal (Figure 6). The bulk of the precipitation began mid-June just prior to commencement of the NRCS plan.



When fields, saturated from flood irrigation receive rain, the response in streamflows is relatively quick due to surface runoff directly into streams. This hydrologic response, observed at the USGS and DNRC continuous streamflow stations, is considered flashy under these circumstances. The response observed at the Big Hole River @ Saginaw station, which is above most irrigation, is much more subtle than the other two stations (Figure 7). A more detailed assessment of precipitation effects on streamflow would require intensive basin modeling and is beyond the scope of this effort.

Increased Flows

More than 300 cfs was allowed to bypass headgates in the tributaries and mainstem of the Big Hole River over the course of the three phases of implementation. That value is equal to the accumulation of all measured water on the day of each phase implementation.



Between the initial adjustment to headgates on June 21 and June 27, the remainder of the high elevation snowpack melted (8.4 inches SWE). In addition, mountain and valley precipitation was occurring throughout the implementation of the project and therefore measured values are only instantaneously accurate. In other words, subsequent readings may have been significantly reduced or in some cases elevated over those at the time of shut down due to naturally declining or rising streamflows. In some cases, especially on tributary streams, headgates that can be regulated do not exist and therefore diversion amounts have historically been a function of water availability. As well, it is highly likely that some water allowed to bypass headgates was picked up by other diversions downstream.

During the summer of 2004, timely precipitation was occasionally responsible for keeping instream river flows above 20 cfs at the Wisdom Bridge. The hydrologic response to summer precipitation was likely much greater than in recent years due to closed headgates deferring storm related flows in-channel. Water normally captured by diversions, was now allowed to bypass and remain instream. Following a storm response in late June, flows at Wisdom were rapidly declining. It is likely that without Phase 1 reductions, flows would have dropped below 20 cfs. Figure 8. shows the hydrologic response to the initial phase of the plan. An unnatural attenuation of recession flows was observed on June 21 and for several days following. In this case, the attenuation was a direct result of the cessation of diversion as implemented by the plan and not a function of precipitation. Some mountain precipitation did occur on June 21, however lag time precludes that event from impacting the initial attenuation of the hydrograph. The hydrologic effects of the implementation of Phases 2 and 3 are much less obvious. With the remainder of snowmelt occurring the week prior to Phase 2 and accompanying mountain and valley precipitation, it is difficult to precisely quantify streamflow contributions of the second two phases of the plan. However, significant increases in flow do coincide with the commencement of each phase. The dramatic positive response observed in the hydrograph is a function of snowmelt, precipitation and closed headgates (Figure 9).

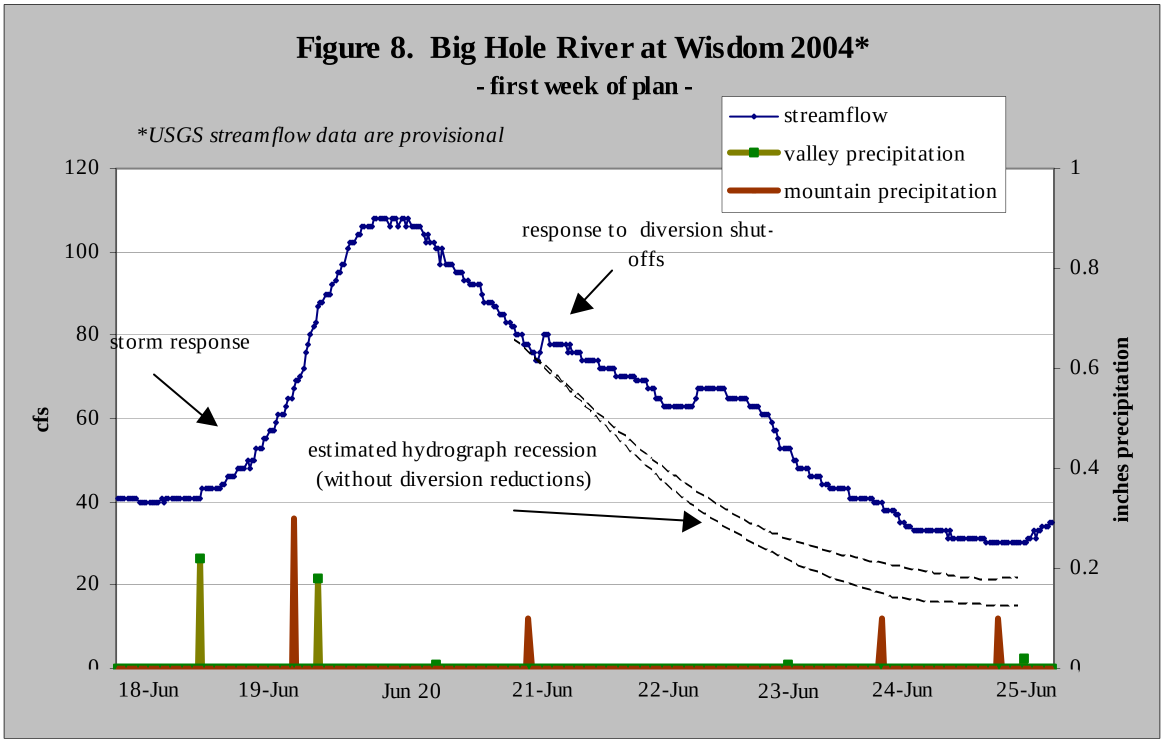


Figure 8. Big Hole River at Wisdom 2004*
- first week of plan -
*USGS streamflow data are provisional
streamflow
valley precipitation
mountain precipitation
response to diversion shut-offs
storm response
estimated hydrograph recession (without diversion reductions)
cfs
inches precipitation
0
20
40
60
80
100
120
0
0.2
0.4
0.6
0.8
1
18-Jun
19-Jun
Jun 20
21-Jun
22-Jun
23-Jun
24-Jun
25-Jun

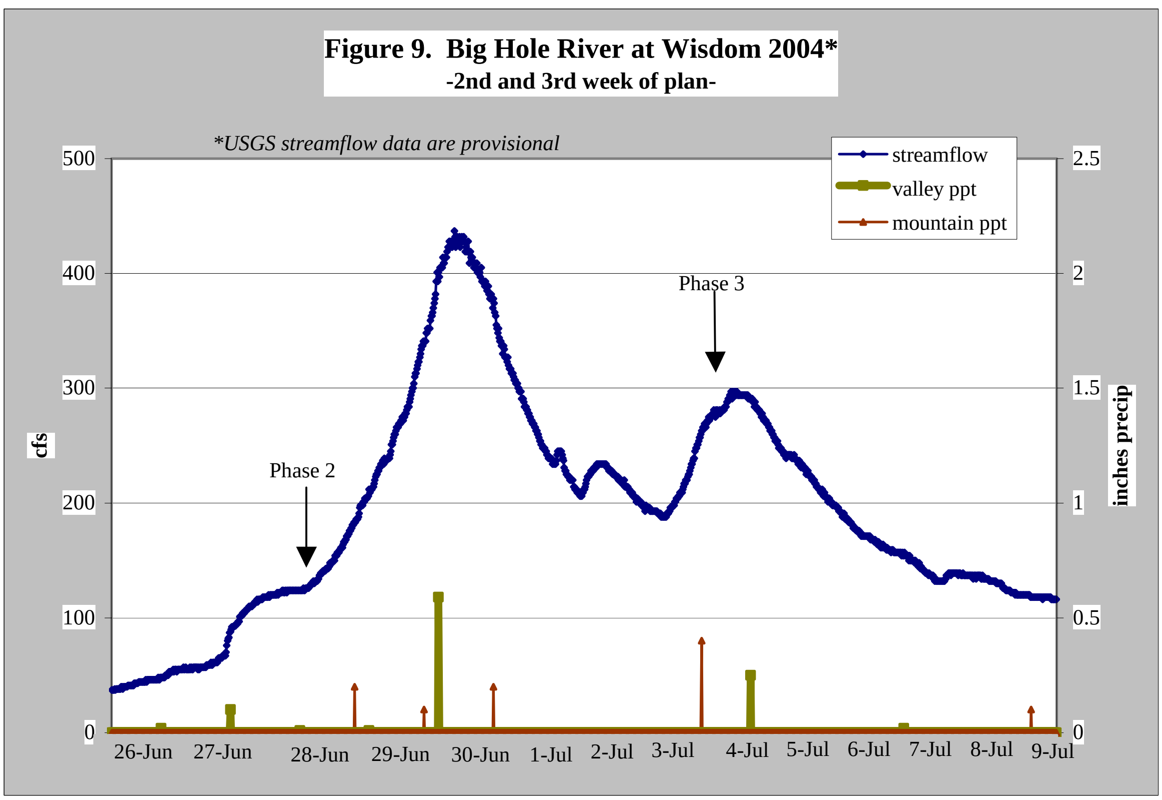
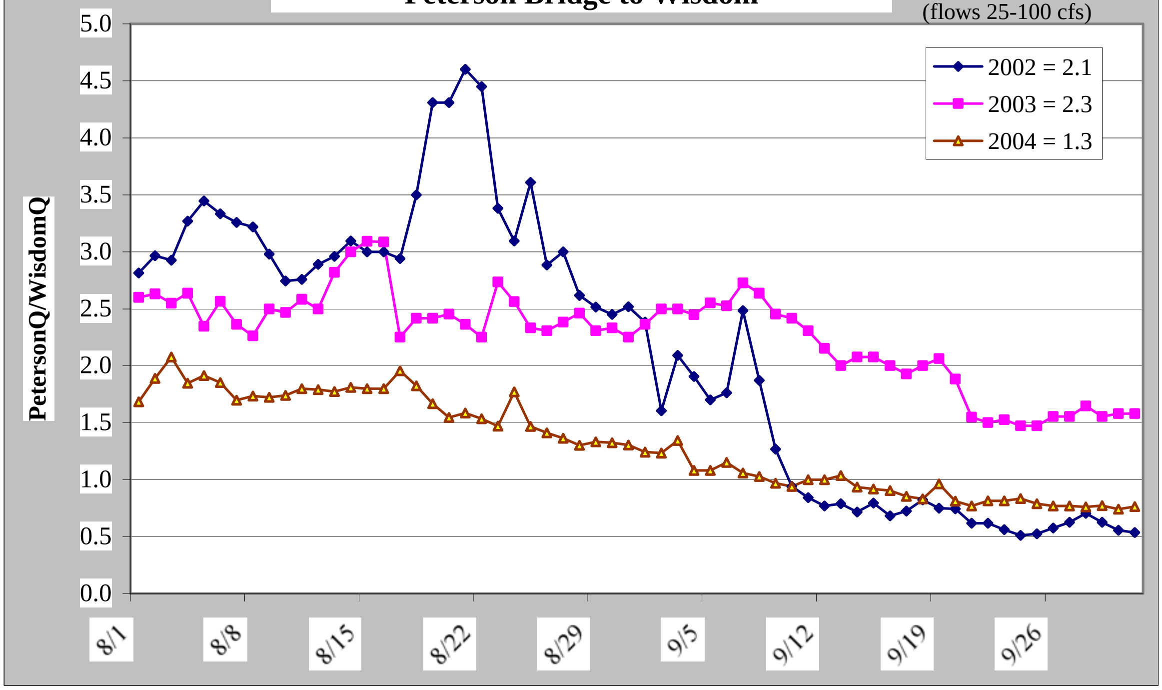


Figure 9. Big Hole River at Wisdom 2004*
-2nd and 3rd week of plan-
*USGS streamflow data are provisional
streamflow
valley ppt
mountain ppt
Phase 2
Phase 3
cfs
inches precip
0
100
200
300
400
500
0
0.5
1
1.5
2
2.5
26-Jun
27-Jun
28-Jun
29-Jun
30-Jun
1-Jul
2-Jul
3-Jul
4-Jul
5-Jul
6-Jul
7-Jul
8-Jul
9-Jul

Following hay irrigation and snowmelt, river flows generally declined throughout the summer. Precipitation inputs continued to contribute to streamflows. A change in the relationship between river flows at Peterson Bridge and at Wisdom was observed. In 2002 and 2003, flows at Peterson Bridge were approximately twice flows at Wisdom during this period. During 2004, flows at Peterson Bridge were 1.3 times flows at Wisdom (Figure 10). This is an indication that a higher percentage of streamflow remained in the river in 2004 and that is likely due to reductions at headgates, greater tributary inputs, and precipitation. A similar relationship was observed between river flows at Saginaw Bridge (above irrigation) and river flows at Peterson Bridge.

Figure 10. Big Hole River Late Season Flows Peterson Bridge to Wisdom



On several occasions, daily average flows at Wisdom approached 20 cfs but never fell below that threshold. During the last six years of drought, 2004 is the only year where daily flows never averaged below 20 cfs between July 1 and Oct 1 (Table 2). Observations of snowpack conditions and summer precipitation indicate this was largely a function of summer precipitation and most likely closed headgates that did not capture flows associated with storm events.

Number of days <20 cfs at Wisdom Gage			
	number of days	1-Apr	Precip
year	(July 1 - Oct 1)	SWE (%)	May-Sept
1999	5	110	4.3
2000	51	86	3.5
2001	59	61	6.6
2002	6	82	7.2
2003	45	106	3.7
2004	0	74	10.3

Table 2. Flow days below 20 cfs at Big Hole River at the Wisdom streamflow gage.

Evaluation and Observations

Based on the data presented in this report, it is evident that the implementation of the NRCS-EQIP emergency plan had an effect on streamflows during the 2004 irrigation season. It is also clear that precipitation played a major role in maintaining those streamflows. Other observations include:

1. No emergency listing of the Arctic Grayling.
2. Phase 1-diversion reductions kept river flows above 20 cfs at Wisdom during first week of plan.
3. Average daily flows at Wisdom never fell below 20 cfs between July 1 and Oct 1.

4. By shutting headgates, precipitation-increased flows were allowed to stay in river (i.e. hydrologic response from storms were much greater under EQIP plan conditions).
5. Proposed stock watering facilities address long-term solutions to late season diversion.
6. Some conservation efforts were conducted voluntarily by landowners in the upper basin (i.e. some landowners gave water up without compensation).
7. Increased instream flows were realized in other sections of the watershed besides the Big Hole River at Wisdom.
8. Not all water left instream at headgates made it to Wisdom. In many cases, "saved" water was captured by another diversion downstream.
9. Precise quantification of plan-contributed flows at Wisdom was difficult due to precipitation inputs and massive number of diversions in upper basin.
10. Monitoring indicated that some participants were not in compliance with their contracts and adjustments to compensation were subsequently made.

The development of this plan was clearly designed to provide mostly short-term benefits to streamflow while compensating those irrigators who participated by shutting down streamflow diversions. Long-term benefits include local public awareness of critical low flow conditions that periodically occur in the upper basin, greater knowledge of irrigation and streamflow interactions, and development of agency/landowner relationships that may be key for further management of water resources in the upper Big Hole River Basin.